

Multimedia and Architectural Disciplines

**The 13th European Conference
on Education in Computer
Aided Architectural
Design in Europe**



**PATRIARCH: A
HYPERMEDIA
ENVIRONMENT
FOR THE
SUPPORT OF
ARCHITECTURAL
DESIGN**

Ezio Arlati

Department of
Programmazione,
Progettazione e
Produzione Edilizia
Facoltà di
Architettura,
Politecnico di Milano
- Milano, Italy

Abstract

This paper reports on current research in the field of architectural design and knowledge-based systems, through the conception and implementation of two software tools operating as a part of an integrated hypermedia environment denominated PatriArch. Main concern of this set of tools operating in PatriArch is the support of design since the very beginning, in that phase of not yet correctly explored or interpreted constraints and of scarcely specified goals, in which an initial solution model – provisionally composed of fragments of supposed fitting ideas – for the design theme has to take place. The creative activity of the designer is assumed as an 'intentional planning activity' that represents the acquired level of knowledge of the network of connections defining the nature, function, shape in the space etc. of the increasingly integrated solution-model: the final design will be an evolution of this - and other competitive and concurrent - models. PatriArch is ment to be the environment containing and allowing the representation of this evolution through its ability of linking the fragments of designers' knowledge, supported by an integrated relational data base: Sysinfo. These works were conceived inside an educational software development program for architecture students.

Introduction

The main goal of these software tools is to provide the designer – and the student- designer through a guided educational experience - an integrated environment in which the technological approach to the architectural design activity can be performed, i.e. the set of languages and tools unabling to represent the 'fabrics' - or network – of interrelated factors leading to a correctly founded design decision.

Besides the intrinsic content of the proposed methodology, the explanation to students of an architectural design theme through an integrated multimedia environment and its set of software tools allows to communicate the richness of cultural and technical values - that are the references for the designer's knowledge - in a much more understandable and living way than verbal exposition about complexity of architectural design.

The teacher's communication effort wanting to explain the width and variety of the cooperating factors for the conception of a design theme can be performed with the support of the software tools presented in this paper, operating through the evident concreteness of the architectural objects by the descriptive instruments of the different branches of instructions or sectors of technical knowledge; this also allows to introduce the interlacing and reciprocal influence among the decision factors in architectural design.

These knowledges can be expressed, as in the current research and education experience, by a set of media supporting vision – videotapes, videodisks, videocamera, soundtapes, - integrated with a software

environment in which different categories of tools operate at different levels: as technical instruments devoted to single tasks (drafting, text, spreadsheet, calculation) or as specialized agents representing the design process (PatriArch) or supporting it by technical information (Sysinfo).

The designer's work exists towards a symbolic representation system, the learning of which - shades and connections importance - can directly be experienced by the student, if he works to the description of an architectural object or to its modifications: in this way using an informatical tool that shows the links between building's "structural parts" not only like physical dimensions but also like functional parts or performances, trains the student to understand the project as a description of an organism's complexity that doesn't extinguish in a form.

Sysinfo - Relational Data Base of Technical Information - the second software's tool available to the integrated environment, represents a lot of technical informations to which the student refers to get a solution in his designs' exercises.

Using Patriarch & Sysinfo as a didactical tool means to approach some students to these softwares and, after having attended to the teacher's lesson, they can directly experience what learned, working on computer, under the teacher's supervision. It is necessary to get this didactical purpose to have a certain number of networking stations and a long-term didactical programmes: the goal of the following two institutes, CEDAR, that generated the "Sezione Documentazione Materiali Edili", and "Laboratorio di Sperimentazione dell'Architettura" that was founded in the P.P.P.E. Department, is to provide to an informative and didactical service.

The problems' resolution jumped out during the creation of a new version of the Patriarch & Sysinfo's software, i.e. to implement the schoolroom's computers net, is going to a good solution; it is difficult to understand the better software's solutions to make the software able to work into a progressive operating system and able to support the high informations' exchange between DataBase and data processing's software in many simultaneous users' net. Actually the software works in Windows '95, Windows N.T. and Netserver.

The project complexity

Actually the main technical problem we have to solve, from a planning point of view, is to check the architectural object's complexity and its conceiving/achieving process.

This complexity, mostly in the building and architectural industry, is created by the expression of the knowledge's heterogeneity and the technical skills, by its expression languages, by laws setting up a standard reference, by the presence of a lot of operators with a lot of different roles - when they aren't conflicting each other-, by the interference caused by the decisions due to several operators.

A particular connotation of this complexity consists in a lack of an expression language - if not in a concrete disclaimer - that organically represents nature and *the theories' hierarchy in planning's decisions* (in the worst way it take place the waste to attribute a recognizable and evaluable structure to the planning's theories).

The architectural plan's complexity lives in the following characteristics.

The planner's action

The development of the actual cognitive approach to the architectural aided design sets out to provide an integrated tools set to support the configuration's progressive research and plan's definition, directly performed by the planner.

The idea, to which contemporary researches refers, defines planning as a "philosophical" decision process based on a multiform knowledge divided into a lot of "rules" and competences: planning is a total activity based on knowledge's rules that causes a non-linear evolution, but copresent and repetitious, of the qualifications' whole and relative solutions, through a continuous and mutual adaptation. (Smithers, 1991). This idea shapes the plan like a solution definition's process to the theme's qualification, based on the recourse of "knowledge's thesaurus" in which the planner's learned is expressed as well as on his professional, technical and procedural experience in solving similar subjects: "planning" activity is essential to this idea.

The step of our conception of a planning aided design's integrated informatical system consists in being able to play a plan as a lot of connections that acquire more and more identity, that builds a well structured whole, in which every single part is the solution to each single problem and at least to the whole planning theme.

Requirements for "system assistants" for the support of architectural design activity

System assistants operating in an integrated environment for the support of architectural design should answer the following set of requirements:

- the ability to represent solution models in course of elaboration: that is, the ability to describe a solution model at any state of elaboration of the project, including early and scarcely "denominated" phases. Moreover, this temporary solution model should be subject to elaboration by other domain specific tools operating within the environment, thus allowing manifold verification procedures, at the required level of detail. This allows architects to select amongst different solution models at any stage of the process, following a heuristic approach typical of design activity.
- the ability to support architects' effort in the formulation of solutions, that is of manipulating the appropriate technical languages in the synthesis of preliminary solution models, coherently with the progressively denominated information acquisition process typical of architectural design
- the ability to represent in a *continuum* the growth in specification of the knowledge contained in project models, from early phases in which intention and strategy take shape up to the development of the final object denominated with the appropriate technical languages
- the complementary support of a structured set of evaluation tools, apt to assume the solution model at its various stages of development, and to accompany the growth of the model towards its completion, by means of the application of evaluation paradigms with increasing level of precision.

The activity of system assistants in an integrated environment

In the integrated conception of an environment supporting architectural design here proposed, several functions, pertaining to different tools and agents, should be organically and sinergically composed in a global coherent structure. These tools and agents thus operate in an integrated environment subject to the control of the architect. This integrated set of assistants is aimed at the satisfaction of two basic groups of functions:

- supplying architects with the widest possible range of support functions, in the phase and with the language appropriate to different tasks. This is done by means of the following basic functions: – the search, retrieval, acquisition and supply of technical information pertaining to materials, procedures, building techniques etc. necessary to the architect during any specific phase of any project task – the activation of a wide range of description tools, so as to cover the whole set of specific technical languages expressing a project (sketches, graphs, diagrams, text, tables etc.) with the ability to establish connections and interdependencies among files (e.g. database, object oriented CAD etc.) – the activation of a wide range of tools responsible for attributing quantitative values, following the various calculation procedures underlying the design process
- allowing the construction of a globally coherent structure representing the logic of a globally coherent structure representing the logic of interrelations among the various significant factors of design projects - cultural, formal, technical, building regulations etc. - apt to describe the project during the phases of its evolution, through the navigation of information and knowledge domains, following a self-determined route. In other words, the environment should enable the representation of the map of these interrelations as a graph of connections capable of automatic activation of the information quanta selected, as well as the storage of stages of this map of interrelations, so as to allow its control, verification and modification progressively and recursively. This tool is also responsible for the storage of the explicit description of all materials and elaborations making up a project, thus making the entire process transparent and legible.

The development of an integrated environment for the support of architectural design as the one described, which we call Patri-Arch, depends on subsequent generations of tools and agents endowed with growing levels of complexity and ability to memorise and use previous knowledge acquisitions.

In this paper we present the object of our research and experimental activity, that is the development of didactic software objects aimed at putting into practice the paradigms described in the paragraphs above. Other tools and agents are under feasibility analysis and will be the object of following papers.

Patri-arch

Up now we showed you the general characteristics of a planning environment like Patri-arch; in particular the developing experience of this didactics objects brings to produce instruments and agents able to work in the Patri-Arch's integrated planning environment, to support the specific answers of the planner.

The planner's creative operation consists in thinking an hypothesis of solution that is the expression of his knowledge and experience; the following phases will show the developing of this idea in a model that became, progressively, more articulated with the informations it acquire.

The planning model will grow towards the final stage, the executive plan: the plan will progressively enrich with specifications that develop all the geometric attributes, services, technical constructions, that will be brought in the final documentation as drawings, technical specifications, cost estimate, contractual documents.

If the integrated informatic environment has the duty to give hospitality to the whole planning model from connection to final definition, one of the instruments we have prepared is Patri-arch: it must help the planner in collecting, assembling and showing pieces of knowledge coming from as heterogeneous as different technical and professional fields.

The milestones of the planner's knowledge (the human intelligence is irreplaceable) are two:

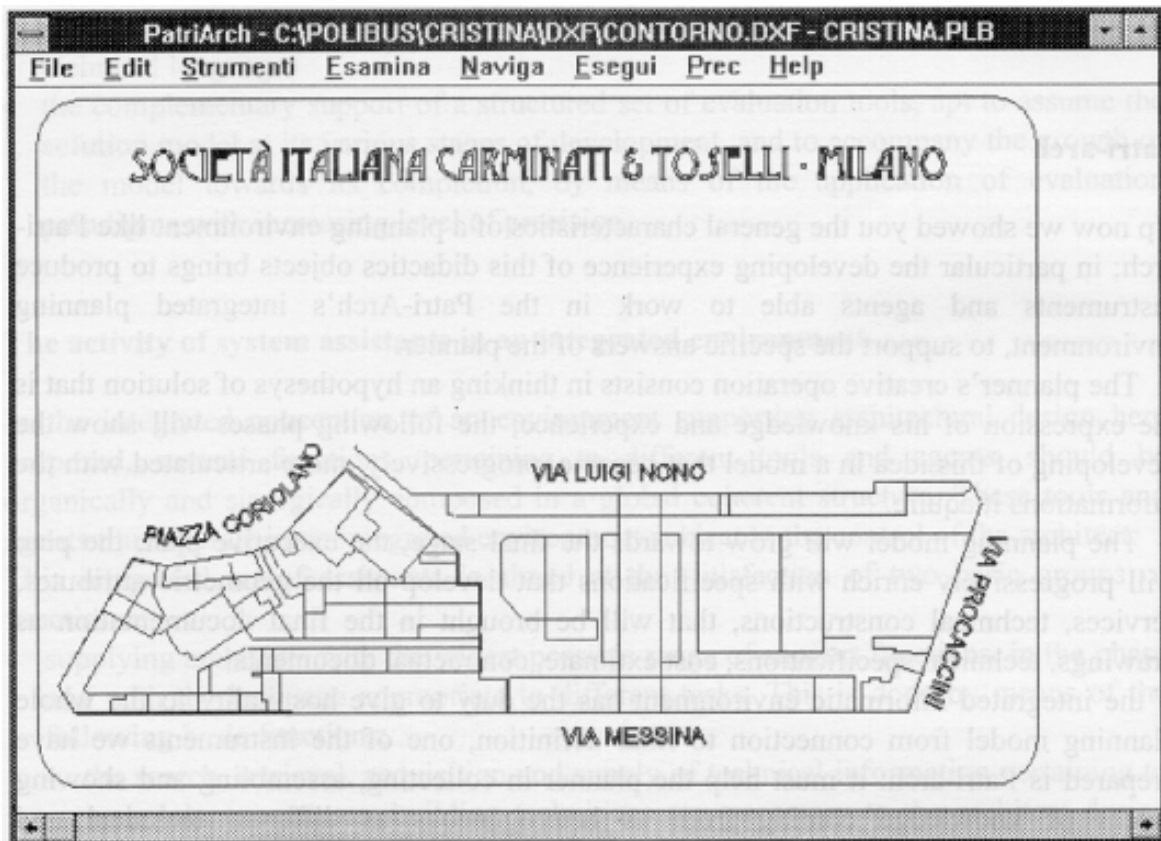
- to define the purposes, the objectives and the final goals of the planning;
- to describe clearly the economical and juridical bounds who play in this context.

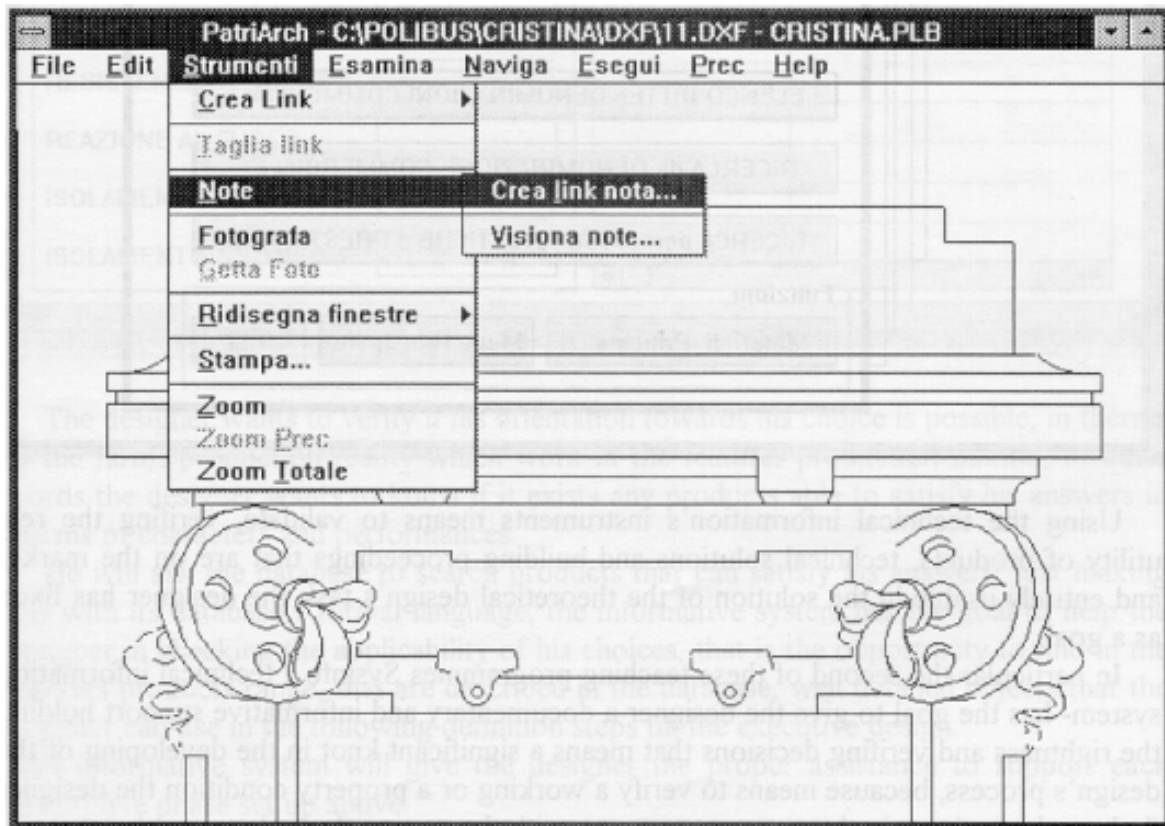
The planner's knowledge works through a lot of different interdisciplinary fields, being able to catch and to link the essences of the matter.

The planner works in an informatical environment and has to solve some problems like to show the planning models and the relationships, using several softwares.

The Patri-Arch's task is just to link several files coming from different softwares: texts, worksheets, pictures, drawings, and chart now can work together under the same context.

Now the planner will have more time to spend to improve the research for further solutions because the Patri-Arch's net of links reports a step by step of the growing of the project and allows to update every step.



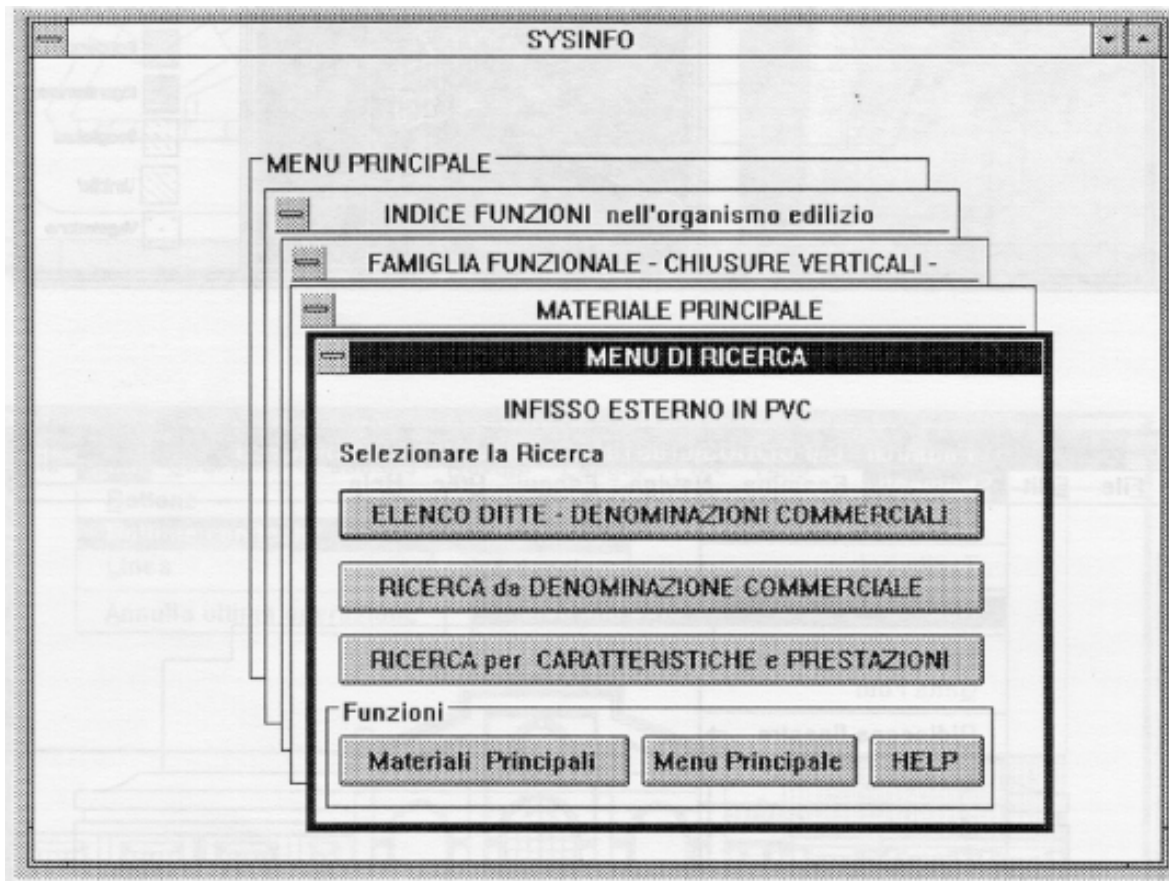


Sysinfo

The main point (the main points) of the operation of using an informative system supporting the human design's action must be to give the designer what he needs, proper information, in a right form file, being able to import in the context of a design's model he is developing, to accede in a direct way, transparent to the software's interface and navigation in the informatic place.

The designer needs etherogeneous informations because etherogeneous is the subject of the knowledge's sectors the designer uses and asks to compose the various aspects he is interested in to define his specific design's model.

Again, technical informations must give the planner the possibility to know most of possibilities in therms of market opportunities but also of connected juridical bounds to rich the goal of the design's theme in which the designer is involved.



Using the technical information's instruments means to validate, verifying the real utility of products, technical solutions and building proceedings that are on the market and entirely usable in the solution of the theoretical design's task the designer has fixed as a goal.

In particular the second of these teaching programmes Sysinfo - technical information system- has the goal to give the designer a documentary and informative support holding the rightness and verifying decisions that means a significant knot in the developing of the design's process, because means to verify a working or a property condition the designer finds as determinant in that moment to go on with the current design's research.

The planner works as following:

firstly he draws a planning model in which he has already recognised the typological features; now the definition level of this work is in a primigeneous form, he hasn't yet a structural language and technical characters that will develop the architectonical and constructive nature of the building.

Now the designer identifies a particular kind of form he wants to award a characteristic element of his design for windows or fixtures, this means to define fixtures with a particular form and technical detailed lists in terms of characters, possibility of making curve forms, and performances.

In this way the designer will extract from the database the informations that replies his choices in the actual definition phase.

RICERCA per CARATTERISTICHE e PRESTAZIONI

Funzioni FUNZIONI Ricerca SELEZIONI Help

Caratteristiche DIMENSIONE <input type="text"/> <input type="text"/> POSIZIONE GUARNIZIONE <input type="text"/> TIPO DI APERTURA <input type="text"/> COLORE <input type="text"/>		Classificazione FAMIGLIA FUNZIONALE <input type="text"/> MATERIALE IIP <input type="text"/> Infissi verticali <input type="text"/> PVC <input type="text"/> SI <input type="text"/>																							
Prestazioni NORME DI RIFERIMENTO <input type="text"/> PERMEABILITA ALL'ARIA <input type="text"/> TENUTA ALL'ACQUA <input type="text"/> RESISTENZA AL VENTO <input type="text"/> REAZIONE AL FUOCO <input type="text"/> ISOLAMENTO ACUSTICO <input type="text"/> ISOLAMENTO TERMICO <input type="text"/>		Caratteristiche TIPO DI OSCURAMENTO <input type="text"/> TIPO DI VETRO <input type="text"/>																							
		<table border="1"> <thead> <tr> <th>DITTA</th> <th>DENOM. COMM.</th> </tr> </thead> <tbody> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> </tbody> </table>		DITTA	DENOM. COMM.																				
DITTA	DENOM. COMM.																								

The designer wants to verify if his orientation towards his choice is possible, in terms of the firms' production reality which work in the features' production market, in other words the designer wants to know if it exists any products able to satisfy his answers in terms of characters and performances.

He will ask the database to search products that can satisfy his answers: just making this with its database's formal language, the informative system has the goal to help the designer in checking the applicability of his choices, that is the opportunity to find in the markets' products range, that are described in the database, well detailed objects that the designer can use in the following definition steps till the executive design.

This informative system will give the designer the proper assistance to support each descriptive phase set up above.

If the database will give a positive answer to his requests, the designer gives up from the store - data bank the necessary informations in the form of object's description, with its law's reference, vectorial drawing of significant technical details, chart or bitmaps needful to support his following detail's choice.

SINTESI

File Funzioni Link Programmi Help

Scheda alfanumerica

Codice Prodotto

PRODOTTO

DITTA

DENOM. COMMERCIALE

MATERIALE PRINCIPALE

Bottoni

1

2

3

4

5

6

7

UNI

Prestazioni

Permeabilita' all'aria

Tenuta all'acqua

Resistenza ai carichi di vento

Isolamento Termico K

Isolamento Acustico db

Scheda grafica

Sistema	Nodi
RIVA6	B
RIVA5	A
RIVA5	B
RIVA6	A

Marchio Ditta

Bottoni

PV

SO

SV

C

3D

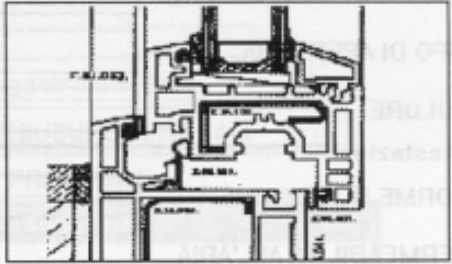
P.O

DM

G

A/V

Sezione



Conclusions

The idea that inspired the Patri-Arch's creation is to bring a planning developing environment able to show its heterogeneity towards the use of an informational tool set.

These specific tools haven't been deliberately created for Patri-Arch, but they are ready-made tools on the market, and for this reason, quickly improved.

Patri-Arch is a "software box" that means to collect the other softwares called to work inside its sphere and connected each other by our hypertext. This software is an operative procedure thought to give the designer - on his portable computer in every time and in every place - the whole plan, to verify the agreement among the plan and the constructive building.

References

Akin, O. 1986. *Psychology of Architectural Design*. London: Pion.

Arlati, E., Bottelli, V., Fogh, C., Tirassa, M., 1995. *Modelling process knowledge in architectural design - a case-based approach*, Intersymp 95. Baden Baden.

Bottelli, V., Drago, P., Fogh, C. 1994. "Advances in knowledge-based building design systems" in: Pohl J. (ed.), *Can preconditions of architectural projects be considered as cases? Development of a case-based tool*, Windsor: Windsor School of Computer Science.

Colajanni B., De Grassi M., Di Manzo M., Naticchia B. 1991. "Proceedings of the 1st International Conference on Artificial Intelligence in Design." *Can Planning be a Research Paradigm in Architectural design?*. Edinburgh.

Kolodner, J. 1993 *Case-based Reasoning*. San Mateo, CA: Morgan Kaufmann

Pohl, J., Myers L. 1994. "Knowledge-based Computer-aided Architectural Design" in: Carrara G. and Kalay Y. (ed.), *A distributed cooperative model for Architectural Design*. Amsterdam: Elsevier.

Winograd, T., Flores, F. 1986. *Understanding computers and cognition*. Norwood, NJ: Ablex.

Arlati, E. 1992. "La 'Qualita Globale' negli interventi di manutenzione, progetti, sistemi, normative,

controlli, garanzie.", *L'informazione tecnica: supporto indispensabile alla qualità del progetto*. Milano: Ediarch.

Broggi, M., Pietrantonio, M. 1990. "Tesi di Laurea." *Progetto di sistema informativo per il recupero, schede di informazione tecnica di prodotti edili.*, relatore E.Arlati, Dip.PPPE. Milano.

Bogani, E., Ferre, S. 1992 "Tesi di Laurea." *Alla ricerca della finestra perduta, Data-Base Relazionale di Informazione Tecnica alfa-numerica e grafica per le chiusure esterne trasparenti in PVC.*, relatore E.Arlati, Dip.PPPE. Milano.

Drago, P. 1992 "Tesi di Laurea." *Un Sistema Ipermediale di supporto alla progettazione architettonica*", relatori U.Cugini, E.Arlati, Facoltà di Scienze dell'Informazione. Milano.

Cammarata, A., Colombo, C., Graziano, P. 1992 "Tesi di Laurea." *Progetto di Conservazione Multimediale: la Società Italiana Carminati e Toselli a Milano*. relatori M.Dezzi Bardeschi, E.Arlati, G.Pertot, Dip.TTR. Milano.

Gatti, M. 1992 "Tesi di Laurea." *Studio di un prototipo di interfaccia utente per un sistema CAD ad uso di architetti progettisti*. relatore E.Arlati, Dip. PPPE. Milano.

Barrese, C. 1994 "Tesi di Laurea." *Le alternative tecnologiche nel processo di costruzione. Controllo del processo costruttivo in un ambiente di Progettazione Architettonica Integrata*. relatore E.Arlati, Dip. PPPE. Milano.